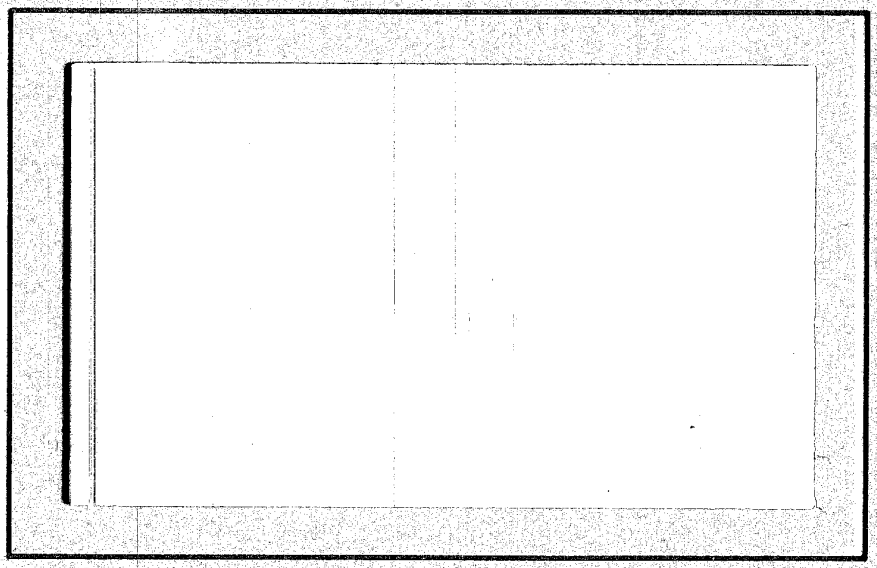
SECRET

4

CONFIDENTIAL

Rec'd SB 4/18/61 1500

Hours



JOB NO. 78-03639A

BOX NO. 16

FOLDER NO. 4

TOTAL DOCS HEREIN 1

25X1

SECRET CONFIDENTIAL

231614/2

CONFIDENTIAL

FINAL REPORT FILE

PROGRESS REPORT NO. 3

ON

~~TASK ORDER NO. M~~

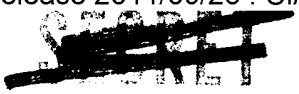
CONFIDENTIAL

CACHING, UNDERWATER

STORAGE CONTAINER

EW-199A

CONFIDENTIAL



CONFIDENTIAL

25X1

April 13, 1961

Dear Sir:

This is "Progress Report No. 3 on Task Order No. M", and it describes the results of the 30-month inspection of the circular-cross-sectioned aluminum-alloy Type 3 containers which are being evaluated under fresh-water-immersion conditions at our Columbus, Ohio, and Daytona Beach, Florida, test sites. Twenty-seven containers were immersed at Columbus on May 7, 1958, and inspected on October 14, 1958, October 1, 1959, and November 1, 1960. Ten containers were immersed at Daytona Beach on May 19, 1958, and inspected on November 5, 1958, November 4, 1959, and November 18, 1960.

A description of the results of the 6-month and 18-month inspections of both the Columbus and Daytona Beach containers was presented in "Progress Report No. 2 on Task Order No. M", dated October 14, 1960.

CONTAINERS AT COLUMBUS

Summary

For the 30-month inspection, seven bare, four anodized*, and one painted containers were retrieved for examination. In the course of retrieval preparatory to inspection, the containers had to be removed from buried positions in the mud bottom.

*The containers which are identified in this report as anodized were actually anodized, dyed, and sealed all over, i.e., on all of the interior as well as exterior surfaces.

CONFIDENTIAL

The detailed examination of the 12 containers showed that, as expected, the bare containers evidenced more corrosion damage than was noted at the 18-month inspection. This damage was particularly more advanced on the cast aluminum-alloy components, such as the flanges and lids.

A significant amount of leaching of the dye had occurred on the anodized containers, especially from the Type 6061 wrought aluminum-alloy handles and retainer clips. The corrosion damage on these parts was slightly more severe than that found on the parts which had retained the dye.

Evidence of dampness to actual measurable quantities of water was found in 6 of the 12 containers inspected. Six of the containers were returned to the laboratory for leak checks and a detailed examination. This investigation revealed that only one container, No. 31, had a leak which was large enough to permit water to enter; this leak was located in the circumferential weld seam between the shell and the flange. Most of these six containers exhibited a ridge of hardened petroleum jelly in or around the O-ring contact line, and for several of these, the leak testing revealed leakage of water past the O-ring seal; when the hardened petroleum jelly was cleaned out, the leakage past the O-ring did not occur. In preparation for immersion of the containers in the water, petroleum jelly had been used as a lubricant for the O-ring surface, to facilitate insertion of the lid. As a result of the above findings, we recommend that a silicone grease be used for such lubrication purposes in the future.

It was interesting to note that, of the 12 containers inspected, only the painted container showed no significant change after 30 months of exposure. It was also found that the nylon-rope lines attached to the various containers and immersed for 30 months were in excellent condition.

Detailed Inspection Notes

Bare Container No. 59

This container had been previously inspected after 6- and 18-month exposures.

An examination of the shell revealed a 1/32-inch-deep pit in the circumferential flange weld, a 0.020-inch-deep pit on the shell about 4 inches from the bottom, and a 1/8 x 3/4-inch strip of shallow etching (0.006 inch deep) on the shell 3 inches below the flange. The heavily corroded shell area previously marked showed no additional corrosion damage. One shallow pit was noted on the longitudinal weld 3/4 inch below the flange. Numerous corrosion deposits were found on the retainer clip, handles, lid, and flange. Shallow pitting was observed under these deposits. No corrosion was found under the tire. The retainer clip and lid were readily removed. The handles were all free.

A slight amount of moisture was noted on the inside of the container in the form of droplets on the ballast bars. The desiccant was pink, and the steel specimen showed a slight increase in the amount of rusting. The O-ring contact line was in good condition.

The container was returned to exposure.

Bare Container No. 33

This container had been previously inspected after 6- and 18-month exposures.

The shell appeared to be in generally good condition, although it was spotted with numerous, small, hard, black corrosion deposits. No evidence

of attack was found under these deposits. A patch of black stain about 1-1/2 inches in diameter was noted near the bottom of the shell and two minute pits were found adjacent to the stain. A considerable number of small white clumps of corrosion product was found on the lid, flange, and clip. One deep pit (1/32 inch deep) was found beneath a corrosion deposit on the edge of the lid; however, only shallow pitting was observed under the majority of the white deposits. Two of the handles were seized, but were loosened by hand; the other two handles, which had been attached to the lines, were free. About 50 per cent of the surface area of each handle was covered with gray and black corrosion deposits, with shallow etching underneath.

After removing the lid, we found about 1/2 cup of water inside the container. The ballast bars had rusted, the desiccant was pink, and the steel specimen was wet and rusty. What appeared to be a hard, yellowish-white ridge of corrosion product was noted at the O-ring contact line to the extent of about 300 degrees around the inside circumference of the flange. This apparent-corrosion line of demarcation was sharp on the outside of the "groove" (i.e., toward the outside of the container) and feathered toward the inside. The O-ring surface of the lid showed only one or two small spots of etching, and flat spots were found on the O-ring at a few locations. No evidence was found on the inside of the container to indicate the location of the leak, so the container was returned to the laboratory for leak checking and examination of the apparent corrosion product in the O-ring sealing area.

After a laboratory examination, we concluded that the yellowish-white material located in a ridge at the O-ring contact line was not corrosion product. This material was hardened petroleum jelly; this jelly had

been used to lubricate the O-ring areas of the lid and flange to permit easy insertion of the lid. Further examination of the container revealed no cracks in the welds or pinhole leaks in the container where water could have entered; consequently, we reasoned that the 1/2 cup of water found in the container had entered past the O-ring. It was then decided to vacuum leak test this container under selected conditions, so as to confirm or refute our reasoning.

To prepare the container for the vacuum leak test, a 1/2-inch-diameter hole was drilled in the bottom, and a 1/2-inch aluminum pipe coupling was inserted in the hole and welded in position. A moisture-indicating powder was sprinkled inside the container. A vacuum pump was connected to the coupling, and the container, with the original lid in place, was immersed in a tank of water. The air inside the container was then evacuated to simulate a differential pressure equal to that exerted on the container at a depth of 30 feet of water.

Two vacuum leak tests were conducted on this container. The first was run without cleaning the hardened petroleum jelly from the O-ring sealing area. This test showed very definite leakage of water past the O-ring.

After the O-ring sealing area was cleaned with methylethylketone and 600-grit emery paper, the second test was run. We found no indication of leakage around the O-ring or anywhere on the container.

This container was put in storage; it was not re-immersed because the bottom had been changed.

Bare Container No. 55

This container had been previously inspected after 6- and 18-month exposures.

An examination of the previously marked etched area on the shell revealed no increase in corrosion attack. One pit, 0.015 inch deep, was found on the shell near the lower handle where the line was tied. A shallow (0.006 inch deep) pit was also found on the shell, and a 0.010-inch-deep pit on the longitudinal weld seam. A new area of shallow etching, about 1 inch in diameter, was noted about 6 inches from the longitudinal weld bead, midway between the top and bottom of the container. Numerous corrosion deposits were found on the handles and clip, with shallow pits underneath. The flange and lid were also covered with corrosion deposits, which had deeper pits (up to 1/32 inch) underneath. The clip and lid were removed readily; the handles were free.

The interior of the container appeared damp with numerous drops of water spotted over the inside of the lid. The desiccant was pink, and the steel specimen had a 1/4-inch-wide strip of rust extending over the full length at one side. The longitudinal weld seam appeared to show a short crack on the inside of the container just below the flange; in view of this suspected crack and of the presence of moisture, the container was returned to the laboratory for leak checking.

Unlike Container No. 33, this container was helium leak tested. (This method of leak testing was discussed in detail in "Progress Report No. 1 on Task Order No. M", dated May 19, 1958.) Two helium leak checks were made on this container, one before and one after the O-ring sealing area was generally cleaned. The test run before cleaning indicated leakage past the O-ring. But, after cleaning, no leak could be found in this area; however, two small pinhole leaks were found in the longitudinal weld seam, and these

were located 7 and 26 inches above the bottom of the container. A rough calibration of these leaks showed that the corresponding leak rates were well below 1 x 10^{-5} atm-cc/sec; this is too small to permit the passage of water under immersion conditions.

This container was replaced on exposure.

Bare Container No. 31

This container had been previously inspected after an 18-month exposure.

The corrosion damage to this container was severe. The shell showed many pits, ranging from 0.006 to 0.015 inch deep. There were numerous corrosion deposits on the longitudinal weld seam, with pits up to 1/32 inch deep. All of the welds had a spongy or porous appearance. Two deep pits were found on the bottom of the container; one was 0.048 inch deep and the other, 0.060 inch deep. Numerous corrosion deposits were noted on the handles, clip, flange, and lid, with shallow pitting underneath. Two of the handles were free; the third was seized but was loosened by hand. The fourth handle had previously been broken off. The clip and lid were readily removed.

Inside the container we found approximately 1/4 cup of water. A light-colored corrosion product covered most of the underneath side of the lid, and the O-ring sealing area on the flange had a ridge of hardened petroleum jelly around approximately 30 per cent of the O-ring contact line. The desiccant was pink; the steel specimen was wet and showed heavy deposits of rust along the edges. The bottom of the interior of the container was covered with moisture and had the appearance of sweating. This container was returned to the laboratory for leak checking.

Because of the severe corrosion and the measurable quantity of water, we decided that this container should be vacuum leak tested in the same manner as was Container No. 33. The vacuum test showed definite evidence of leakage through the circumferential weld between the flange and shell.

This container was put in storage.

Bare Container No. 32

In accord with the over-all inspection plan, this had not been inspected previously.

The 30-month inspection showed a slight etching on the shell about 12 inches from the top and shallow etching over about 25 per cent of the area of the bottom. A few corrosion deposits were noted on the longitudinal weld seam, with shallow etching underneath. Three handles were loose; one handle was seized, but was loosened by hand. Numerous corrosion deposits were found on the handles, with shallow to moderately deep pits underneath. The retainer clip showed deep pitting under numerous heavy corrosion deposits. On the lid and flange, pits 0.044 and 0.039 inch deep were noted under corrosion deposits. The clip and lid were easily removed.

The interior of the container appeared dry. The desiccant was pink. The O-ring contact area was in very good condition.

The container was replaced on exposure.

Bare Containers Nos. 7 and 45

Since four of the five bare containers which had been inspected after 30 months of exposure, as described above, showed either substantial quantities

of water or indications of high moisture content, we decided to inspect two additional bare containers, Nos. 7 and 45.

A definite mudline was evident on both containers and the area below the mudline on each was stained black. Heavy deposits of corrosion product were found on the lids, flanges, and clips. Underneath the deposits on the cast parts was shallow pitting, which was colored black. The pitting under the deposits on the clips, however, was deeper and in most cases the pits were copper colored with small patches of black. Only a cursory examination was made of the shells; no evidence of corrosion damage was found. The clips and lids were removed readily.

The interiors of both containers appeared dry. The desiccants were pink, and the steel specimens were both shiny, with no evidence of rust. The O-ring contact area on each container flange showed a hardened ridge of petroleum jelly. Container No. 7 had the hardened ridge around the entire flange, while the ridge on Container No. 45 extended around only about 10 per cent of the inner circumference.

The O-ring contact area of Container No. 45 was cleaned and polished, and this container was returned to exposure. Container No. 7 was sent back to the laboratory for leak checking.

Two helium leak checks were run on Container No. 7. The first was run before cleaning of the O-ring contact area and the second, after cleaning. A definite leak past the O-ring seal was noted before cleaning, while no leaks could be found any place on the container after cleaning of the O-ring seal area.

Container No. 7 was also replaced on exposure.

Anodized Container No. 10

This container had been previously inspected after 6- and 18-month exposures.

In general, the shell of this container was in very good condition. There were a few minor points of corrosion on the shell where scratches had penetrated the anodizing. All four handles were free. Two deep pits were found on one handle, and several small shallow pits on the other handles. Numerous deep pits up to 3/16 inch in diameter and 0.050 to 0.088 inch deep were noted on the flange and lid castings. The clip appeared to be in good condition, with one pit noted at one point of contact with the flange. No corrosion was found under the tire. The clip and lid were readily removed.

The interior of the container appeared dry and the desiccant crystals were pink. The desiccant cartridge was broken. The metal specimen, which had been inserted after the 18-month inspection, showed two small areas of rust on the sand-blasted side; spots of rust, covering about 1 per cent of surface and uniformly distributed, were evident on the polished side. Traces of very shallow etching were noted outside of the O-ring contact line on the interior of the flange.

The container was replaced on exposure.

Anodized Container No. 37

This container had been previously inspected after an 18-month exposure.

Examination of the shell showed it to be in good condition. Three of the handles were frozen; two were loosened by hand and the other was freed with the aid of a screw driver. The fourth handle was free. Very shallow pits were found on one handle; however, the other three handles showed no attack. Numerous clumps of corrosion product were found on the flange and lid, with slight pitting underneath. One pit about 1/16 inch deep was observed in the flange retainer-clip groove. Three shallow pits were noted under the tire. The corner of one lid lug was corroded to a depth of 1/16 inch. The clip showed etching at the flange contact points. The clip and lid were readily removed.

The interior of the container appeared dry. The desiccant was pink. The polished side of the steel specimen was clean, while the sand-blasted side showed traces of rust dust, which had been picked up from the ballast bars. One spot of white corrosion product was found on the longitudinal weld seam about 2 feet below the flange on the inside of the container.

The container was placed on exposure.

Anodized Container No. 46

This container had been previously inspected after an 18-month exposure.

The shell of this container showed slight corrosion deposits at scratches which had penetrated the anodizing, but otherwise indicated no corrosion attack. The dye was leaching from the bottom of the shell and particularly from the handles. All of the handles were loose. A few small shallow pits were found on the handles. A few small corrosion deposits were

noted on the clip, with shallow etching underneath. The lid and flange were covered with numerous gray corrosion deposits, with the pits underneath ranging from shallow up to 1/16 inch deep. The clip and lid were readily removed.

Between 4 and 5 cubic centimeters of water were found in the container. The desiccant was pink and rust was found on the ballast bars. (There was no metal specimen in this container.) The inside of the container showed traces of white corrosion deposits to the inside of the O-ring contact line, but no traces to the outside of the contact line. This container was returned to the laboratory for leak checking.

A helium leak check of this container after a general cleaning of the O-ring contact area showed a small leak, corresponding to approximately 7×10^{-6} atm-cc/sec, at a point 38 inches from the bottom on the longitudinal weld seam. A helium test before cleaning of the O-ring sealing area showed leakage past the O-ring seal.

This container was returned to exposure.

Anodized Container No. 15

There had been no previous inspection of this container.

The shell was in good condition and no corrosion attack was noted under the tire. All four handles were free. The two top handles had numerous pits, up to 0.035 inch deep. The dye had almost completely leached out of the two top handles. The retainer clip had corrosion deposits at the flange contact points, with marginal to very shallow etching underneath. A few large corrosion deposits were found on the lid and flange, with moderately deep pits underneath.

The clip was removed readily, but the lid was moderately difficult to remove. The desiccant was pink, and the steel specimen, which had been polished on both sides, was rusted over 80 to 90 per cent of the surface on one side and 7 to 9 per cent on the other side. A few drops of moisture were found on the inside of the lid. The O-ring contact line showed scattered patches of apparent corrosion deposits, which were later found to be hardened petroleum jelly; there was no etching under the deposits. This container was returned to the laboratory for leak checking.

The container was helium leak tested both before and after cleaning of the O-ring contact area. A definite leak was found past the O-ring before the cleaning, but, after the cleaning, no leaks were noted any place on the container.

The container was returned to exposure.

Painted Container No. 30

This container had been previously inspected after 6- and 18-month exposures.

The condition of the paint appeared to be unchanged; the number and size of the blisters seemed to be about the same as had been noted at the previous inspections. A few of the blisters were broken; the water inside the blisters had a pH of 6. There was no evidence of corrosion under the blisters. All four handles were loose. The clip showed two small spots of corrosion deposit where the paint had been abraded off. The clip and lid were readily removed.

The interior of the container was dry. The desiccant was blue to pink, and the steel specimen showed a light dusting of rust. The O-ring contact area was in excellent condition.

The container was replaced on exposure.

CONTAINERS AT DAYTONA BEACH

During the retrieval operation, it was found that some of the numbered metal identification tags which had been attached to the nylon lines were missing. This seemingly was not serious since the containers, like those in Columbus, had all been stamped with appropriate numbers during fabrication. However, during the retrieval and the cleaning operation, and before the inspection, we found that the numbers stamped on the containers and the metal tag numbers were not the same, respectively, for two of the anodized containers. To eliminate this inconsistency, it is requested that the Sponsor make selected changes in his three copies of "Progress Report No. 2 on Task Order No. M", dated October 14, 1960. On page 15, "Anodized Container No. 56" should be changed to "Anodized Container No. 53", and on page 17, "Anodized Container No. 53" should be changed to "Anodized Container No. 52".

Summary

For the 30-month inspection at Daytona Beach, six containers - one bare, four anodized, and one painted - were retrieved and examined. These containers, like those in Columbus, were partially buried in mud. The portions of the containers above the mudline were covered with heavy growths of green algae.

A detailed inspection of the six containers after the 30-month exposure period revealed that the condition of the bare container was good; it was generally similar to that noted at the previous 18-month inspection.

There was, however, some increase in the corrosion attack on the Type 6061 wrought aluminum-alloy handles and clips. The painted container remained unchanged after the additional 12 months of exposure and appeared to be in good condition. The anodized containers, however, appeared to show greater corrosion damage than was found on the bare container; the cast flanges and lids exhibited signs of more severe attack than did the shells. The corrosion damage noted was not so severe as that observed on the containers immersed in Columbus.

Detailed Inspection Notes

The exteriors of all of the containers retrieved and inspected were covered with heavy growths of green algae on the portions above the mudline.

Bare Container No. 17

This container had been previously inspected after 6- and 18-month exposures.

Examination of the shell showed numerous small but generally shallow pitting, with a maximum pit depth of 0.010 inch. The lower handle to which the line had been attached had several pits, up to 1/4 inch in diameter and up to 0.030 inch deep. The other handles showed small clumps of white corrosion product, but no evidence of pitting. All four handles were free. Many scattered pits were noted on the retainer clip, with a maximum pit depth of 0.015 inch. A few small flecks of white corrosion product were found on the lid and flange, with no evidence of underlying corrosion. No corrosion damage was found under the tire. The clip and lid were readily removed.

The interior of the container was dry. The desiccant was blue. Traces of white corrosion product were found to the outside of the O-ring contact area on the lid and flange; however, there was no evidence of corrosion attack.

The container was replaced on exposure (without a desiccant cartridge).

Anodized Container No. 53

This container had been previously inspected after 6- and 18-month exposures.

The anodized coating was still in excellent condition. One lug of the lower handle to which the line had been attached had one pit approximately 0.015 inch deep. Two or three very minute pits were noted on the longitudinal weld seam about 6 inches below the flange. The lower handle to which the line had not been attached was seized by corrosion. The other three handles were free, but showed slight "tightness". The groove under the tire, the inner surface of the flange, and the lid showed numerous gray or metallic-colored flecks which appeared to be areas where the anodizing and/or dye had not "taken". Four spots of fairly deep corrosion were found in a localized area, about 2 inches long, on the lip of the flange retainer-clip groove; the maximum depth of this pitting was about 1/32 inch. Other scattered areas of white corrosion product were noted on the flange and lid, but there was no evidence of corrosion underneath. The clip and lid were readily removed.

The interior of the container was dry. The desiccant was slightly pink. Scattered traces of white corrosion product were found on the surface of the lid lip next to the O-ring groove, but no evidence of corrosion was apparent.

This container was returned to exposure.

Anodized Container No. 52

This container had been previously inspected after an 18-month exposure.

Two pits were found on the shell approximately 6 and 8 inches from the flange; these measured 0.014 and 0.016 inch deep. Three pits located about 180° around the shell from the lower handle to which the line had been tied had measured depths of 0.004, 0.014, and 0.010 inch. Two other shallow pits were found on the shell approximately 1 inch from the bottom, near the longitudinal weld seam. One of the lower handles was seized and could not be loosened by hand; the other handles were free. A few small corrosion deposits were found on the flange and lid; only one of the deposits had any evidence of pitting underneath. No corrosion damage was found under the tire. The clip and lid were readily removed.

The interior of the container was dry. The desiccant was pink. The steel specimen showed one rust spot about 1/16 inch in diameter on one side (as had been noted at the 18-month inspection); the other side was bright and clean. The space between the lid and flange above the O-ring seal was partially filled with a soft gelatinous corrosion product, but there was no visible evidence of corrosion attack in this area.

The container was replaced on exposure.

Anodized Container No. 56

This container had not been previously inspected.

A trace of etching was found on the shell about 1 inch above the bottom. One pit 0.009 inch deep was noted on the shell about 2 inches below the upper handle to which the line had been tied. Several pits were found on the lugs of this upper handle; one of these measured 0.030 inch deep. Numerous large corrosion deposits were found on the lid and flange, with no evidence of attack underneath. Some shallow etching was noted on both the flange and shell at the circumferential weld seam. The lower handle to which the line had not been tied was seized and could not be freed by hand; the upper handle on the same side was freed, with difficulty, by hand. The other two handles were free. The clip and lid were readily removed. A small amount of soft gelatinous corrosion deposit was found between the lid and flange; no evidence of corrosion was found under these deposits. The interior of the container appeared dry. The desiccant was pink, and the steel specimen showed traces of brown stain along the edges of both sides.

The container was re-immersed.

Anodized Container No. 51

This container had not been previously inspected.

The dye had faded to a dark-olive-green color over the entire surface of the container. Three of the handles were seized and could not be freed by hand; the other was free. Heavy white corrosion deposits were found where the handles entered the handle lugs. No evidence of corrosion was noted on the handles. A small group of pits occurred on the shell about 4 inches above the lower handle to which the line had been tied; these measured 0.010 to 0.020 inch in depth. One large pit 1/8 inch in diameter and 0.016 inch deep was located on the shell about 14 inches from the flange. Numerous large

corrosion deposits were found on the flange, with moderately deep pits underneath. One deep pit was found on the lip edge of the flange retainer-clip groove; this was 1/4 inch in diameter and 0.090 inch deep. The clip and lid were readily removed.

The interior of the container was dry. The desiccant crystals were pink. The steel specimen showed no evidence of rust. A small amount of gelatinous corrosion product was found on the inner face of the flange and lid above the O-ring contact line, but there was no evidence of corrosion underneath.

This container was returned to exposure.

Painted Container No. 54

The exterior of this container had been previously inspected after 6- and 18-month exposures, but this container had not been opened.

The blistering condition of the paint appeared unchanged. Two of the blisters were broken and were found to be filled with water. There was no evidence of corrosion under these blisters. The two handles to which the lines had not been attached were seized and could not be loosened by hand; the other two handles were free.

The container was not opened, and was returned to exposure.

We would appreciate any comments which you or your associates might care to make with regard to these inspection data.

Sincerely,

[redacted]

25X1

ABW:mlm

In Triplicate

SECRET

CONFIDENTIAL

CONFIDENTIAL

SECRET